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The Miami Conservancy Bulletin

JULY, 1922

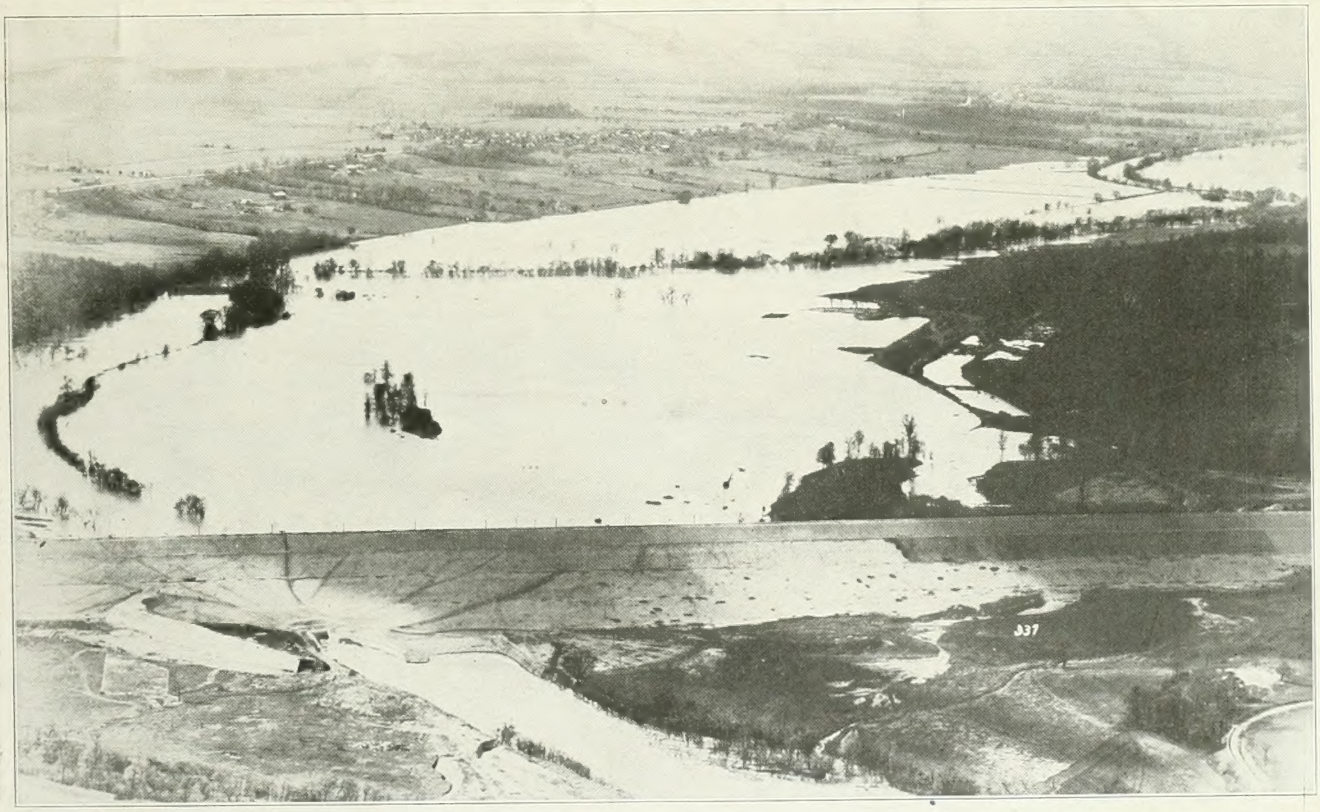

FIG. 363—ENGLEWOOD DAM AT WORK HOLDING BACK THE FLOOD OF APRIL 15, 1922
Photograph by Engineering Division U. S. Army Air Service

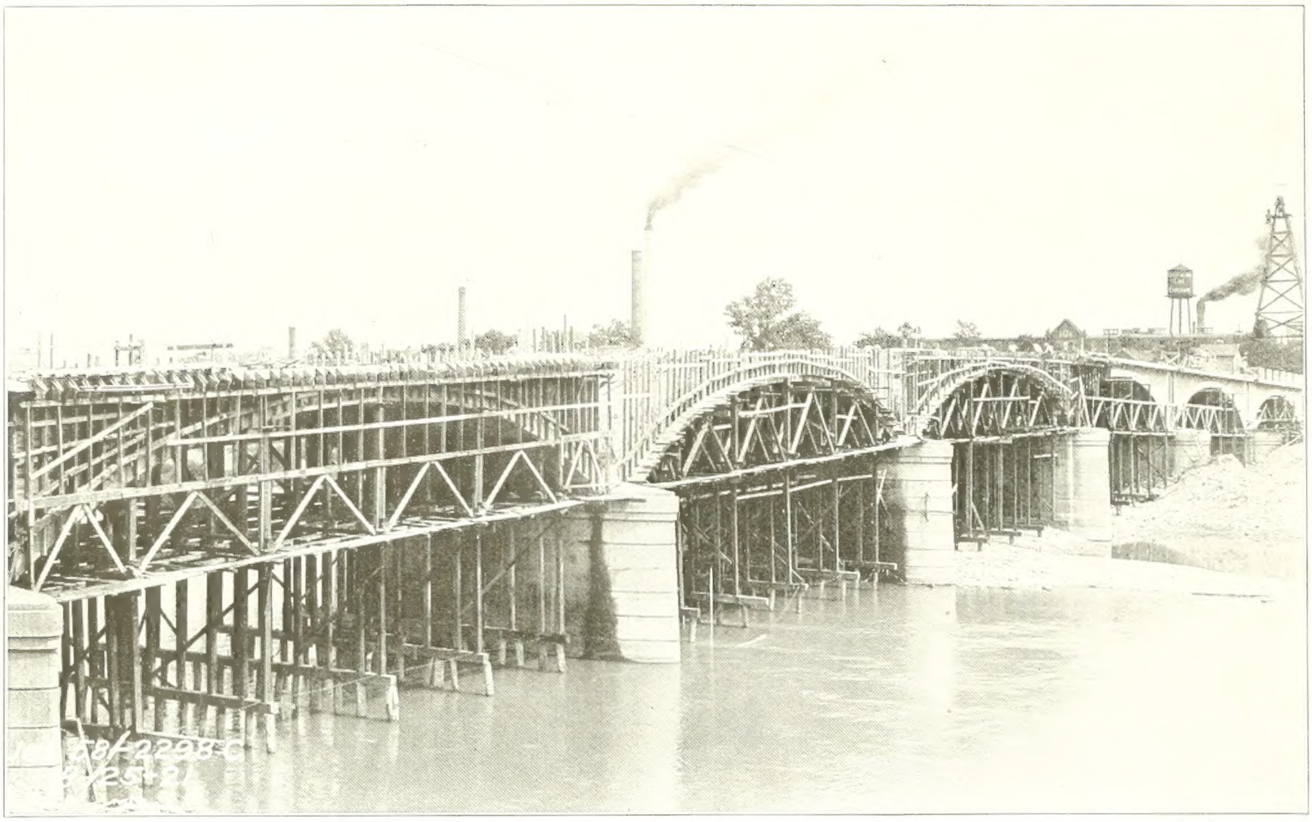

FIG. 364—BLACK STREET BRIDGE, HAMILTON, UNDER CONSTRUCTION AUGUST 8, 1921.

The arches are in various stages of completion. The one in the foreground has the full set of forms for the arch and spandrel walls in place. On the next two the forms are only partly in place. On the fourth and fifth only the skeleton frame work supporting the completed arch remains in place. On the last arch visible, the work is so far along that the posts for the railing are set. The form work is described elsewhere in this Bulletin. The wires overhead and the tower in the background are a part of the cableway used to transport materials and to handle forms.

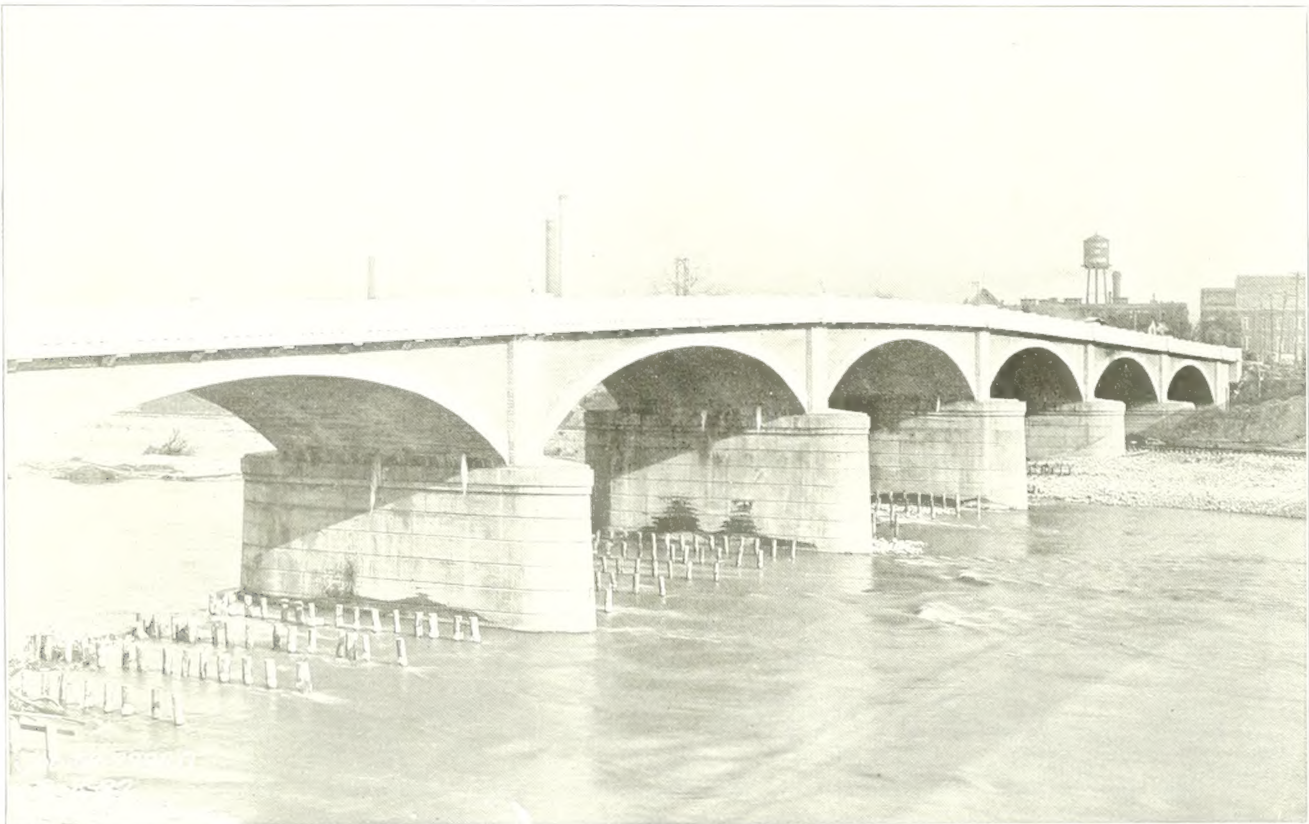

FIG. 365—THE FINISHED BLACK STREET BRIDGE, FEBRUARY 8, 1922.

The view is taken from the same position as Figure 364. The icicles on the under side of the arches mark the positions of the weep holes. The piling underneath has since been removed.

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MIAMI CONSERVANCY BULLETIN
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DAYTON, OHIO

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Subscription to the Bulletin is 50 cents for 12 issues. At news stands 5 cents per copy. Business letters should be sent to Office Engineer, Miami Conservancy District, Dayton, Ohio. Matter for publication should be sent to Bulletin Office, Miami Conservancy District, Dayton Ohio.

Death of John H. Patterson.

John H. Patterson, Dayton's foremost citizen, died on May 7th, 1922. His many achievements and benevolences need no recounting here. One of his most outstanding characteristics was his desire to help others. When disaster overwhelmed Dayton in 1913, his first thought was of what he might do to relieve the distress of the flood sufferers. He turned his whole energies, and devoted his entire organization and plant to relief work. Boats were built under his direction, meals were furnished, and the destitute were sheltered in the factory buildings. While the water was still on the streets, Mr. Patterson was appointed chairman of the Dayton Citizens' Relief Committee by Governor Cox. It is difficult to conceive the extent of this committee's work, so complex and comprehensive did it become. When the need for immediate relief became less acute, the problem of flood prevention was considered. The raising of the two million dollar flood prevention fund will long be remembered by the Miami Valley. Through it all the organizing ability, the vision and the understanding charity of John H. Patterson were inspirations as well as great material aids to Dayton.

Throughout the entire time since the flood prevention work started, his support of the work had been constant, and he kept in close touch with the progress of construction. Just a few days before he died, he was directing the preparation of an article on the benefits of the flood prevention works as shown by the high waters of last April.

A busy life has ended, but the impress of that useful life will long remain upon the community in which it was lived. Flood prevention owes a great debt to John H. Patterson.

Sales Progressing.

The selling of the equipment, materials and supplies for which the District has no further use is progressing in a most satisfactory manner. The total sales at the time this Bulletin went to press amounted to $670,700. The camp houses have been going well, seventeen having been disposed of in one week. Less than ten remain unsold. So far, the sales have exceeded expectations. Much remains to be done. Every effort will be made to bring this phase of the Conservancy work to a prompt and satisfactory conclusion.

Public Confidence.

From the very inception of the Flood Prevention Work the interest of the people of the Miami Valley in it has been very keen. The intense interest aroused during the formation of the District resulted in the general public having an unusually complete knowledge of the fundamental principles of the flood control plan. The construction work has been closely followed by this well informed and critical public as no other public work has ever been. The extent of the public's confidence in the integrity of the work is in this case, more than in any other, a true measure of the success of the undertaking.

The storm of last April afforded an opportunity in a measure of determining the state of the public's mind towards the work. With reports of neighboring communities being flood-stricken reaching them, the citizens of the valley watched the storm without the old time alarm, and went in thousands to look at the basins at work. Above all, privately and through the press, they gave expression to their pride in the work, and to their confidence in the safety of the Miami Valley. Such expression of public approval was very gratifying to the employees of the Miami Conservancy District.

Flood Prevention Proves Its Worth

Miami Valley Saved From a Flood Scare on April 15, 1922.

"The heavy rain of Friday evening caused the Miami River, already swollen by the rain of Thursday night, to rise with great rapidity during the early hours of Saturday morning. During the morning the water reached the danger mark of 18 feet on the Main Street Bridge. Wild rumors of another 1913 flood spread rapidly. Many persons stayed up all night and watched the river. Others moved their belongings into the upper stories of their dwellings. Fortunately the rain ceased Saturday morning. A few hours more of storm, and the situation would have been indeed serious. As it was, water collected in the lower part of town, and damaged . . . . "

The papers of Saturday, April 15th, would have carried some such story as the above if the old conditions had still prevailed. But there was no panic. The citizens viewed the storm with quiet confidence. Less than one hundred telephone calls about the river stage were received by the Conservancy office as compared with two thousand during the high water of 1920. Instead of going on a hysterical rampage, the Miami River behaved sedately and strictly according to plan. The stream was already well filled on Friday night from the effects of earlier rains. The stage increased slowly, but the sudden rush of water early in the morning, was held back by the dams, and the highest mark was only 9.6 feet, reached by 4:00 P. M. on Saturday. Several thousand people went out to see the dams in action. With their pages filled with stories of flood disasters elsewhere, the newspapers retold with evident elation the story of the Miami Conservancy District, and commented upon the accomplishment that has brought safety and security to the Miami Valley. While the flood did not nearly approach the capacity of the control system, it was in a way a test as it gave ocular proof of the ability of the flood control works to do what they were designed to accomplish.

A characteristic atmospheric disturbance passed over the Middle West during the first part of April. It was marked by cyclones and heavy rains. High flood stages were reported from the Mississippi, the Illinois, the Scioto, the Hocking, the Muskingum

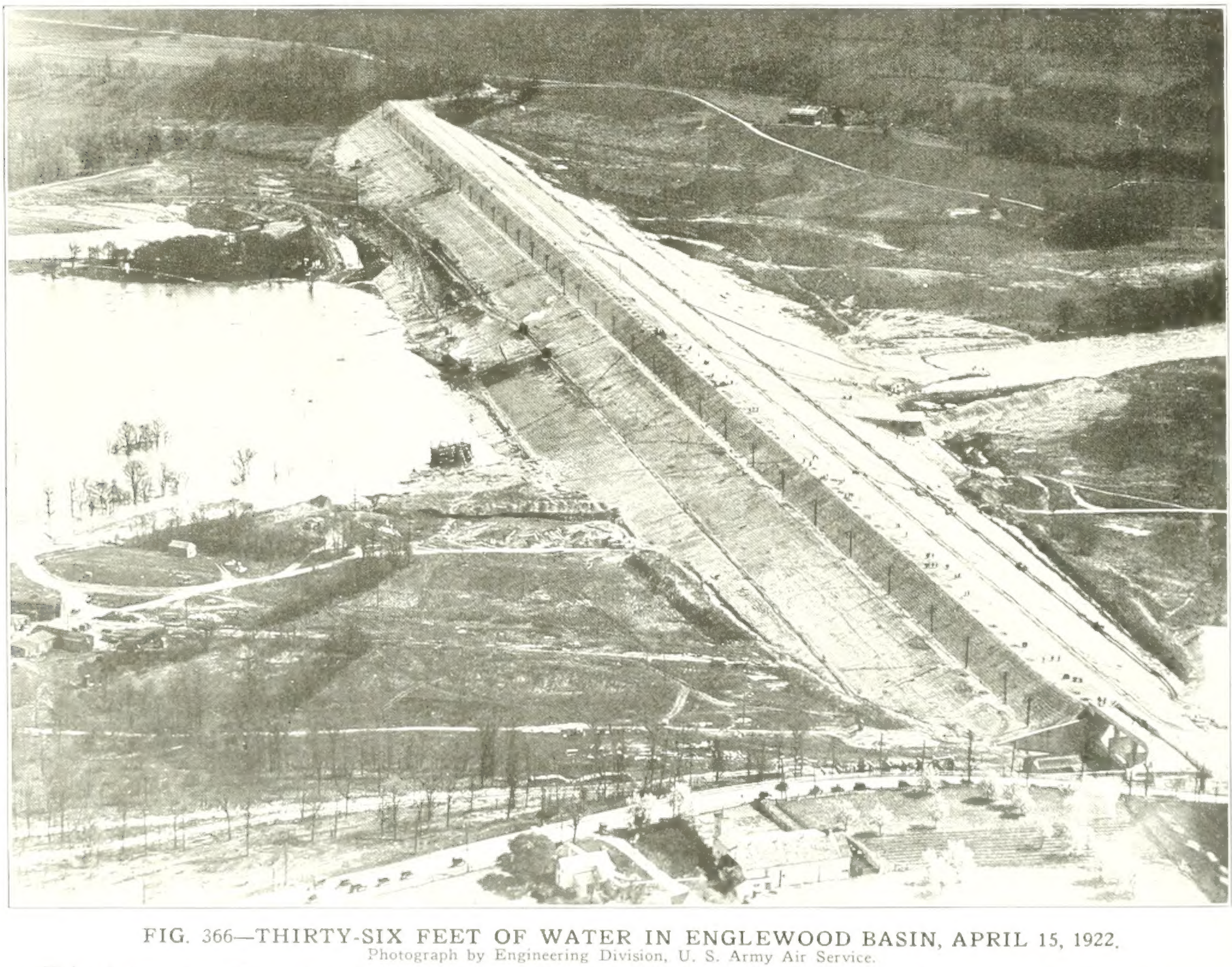

FIG. 366—THIRTY-SIX FEET OF WATER IN ENGLEWOOD BASIN, APRIL 15, 1922.
Photograph by Engineering Division, U. S. Army Air Service.

This picture was taken about the same time as Figure 363 with the aeroplane over the village of Englewood. The structure in the lower right hand corner is the spillway. The black object sticking up in the water close to the dam is the top of the gravel washer. The inlet to the conduits is just back of the gravel washer.

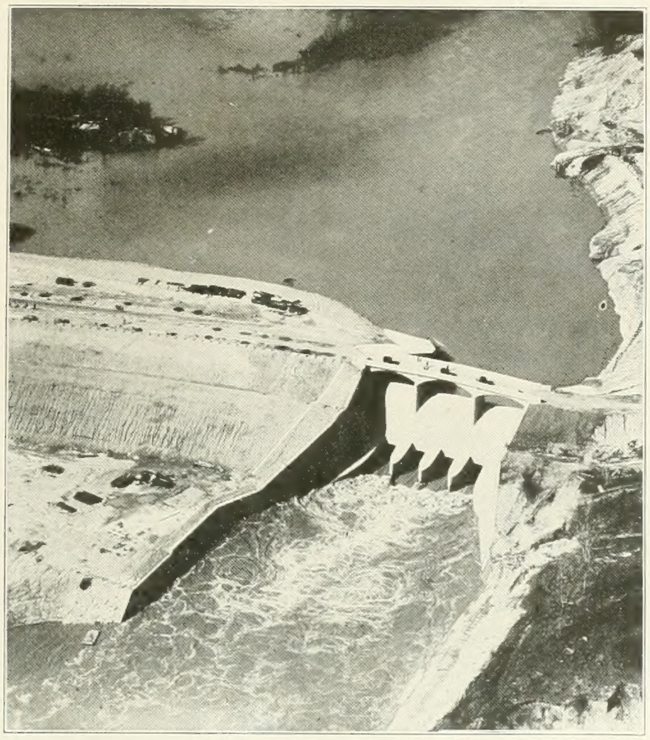

FIG. 367—TAYLORSVILLE CONDUITS APRIL 15, 1922.

Photograph by Engineering Division, U. S. Army Air Service.

The view is taken looking upstream. The water was twenty feet deep over the floor of the conduits. The island in the background is the embankment of the Miami and Erie Canal. The marks that look like scratches on the face of the dam are small gulleys cut in the gravel slopes by the rain. The conduits at Taylorsville are the largest of the five. The graduation from the wild tumult of the hydraulic jump at the conduits to the quiet water at the lower end of the structure is clearly shown.

and many other rivers. Lives were lost, and many persons were made homeless. Trains were delayed, and wire communication interrupted.

Heavy showers and high winds were prevalent throughout the Miami Valley during the greater part of the first half of the month. Hamilton was visited by a destructive hail storm. A wind of cyclonic proportions swept up the east side of the Mad River Valley on the 10th, doing heavy damage to farm buildings. On Tuesday night, the 11th, very heavy showers occurred around Fort Loramie, Sidney and Lockington, and caused a general rise in the rivers. Heavy and general showers occurred at midnight on Thursday, and extended into the early morning hours on Friday. At a number of the weather stations over an inch and one half of rain fell within a few hours. This rain filled the streams, finished soaking up the ground, put some water in the lower parts of the retarding basins, and set the stage for the performance of Saturday.

Friday afternoon a severe rainstorm set in. For several hours the rain poured down in torrents, then lessened in severity and continued until late evening. This rain was general throughout the Valley, although "spotty." An inch and one half of rain fell in a short time in many places. Three and one half inches fell in the twenty-four hours from Thursday midnight to Friday midnight over the greater part of the Valley.

The suddenness of the rain of Friday night, and the water-soaked condition of the ground caused a heavy and quick runoff. The streams above the dams acted just like the Miami Valley streams did in the past, and came up with a rush. The gauge at Pleasant Hill showed 13.2 feet in a few hours, which was a little over flood stage, and the one at Medway registered 9 feet or a foot above flood stage.

The rivers below the dams did not give their usual performance. Instead, they gave an excellent demonstration of the workings of the newly completed system. Dayton is close to three of the retarding basins and has a relatively small drainage area not influenced by the dams. Hamilton is further away, and has a large area, (about 800 square miles) not influenced by the dams. The other towns, except Troy and Piqua, of the Valley are, in position, in between these two towns. The lower part of Figure 368 shows the gauge readings at the Main St. bridge in Dayton. The gauge at this point has been maintained for a number of years. Zero does not mean the bottom of the river as it formerly did, as the improvement in the river has lowered the water level, so that normal low water is now below zero. Therefore, the present day heights cannot be directly compared with pre-conservancy readings. The upper part of Figure 368 shows the storage in the retarding basins. The rains in the upper part of the basin on the 11th are reflected by a long, broad hump in the lower or river stage curve, and there was enough water to cause a small increase in the storage in the basins. The abrupt hump in the river stage curve during the morning of the 14th came from the rains of Thursday night, which were especially severe in the immediate vicinity of Day-

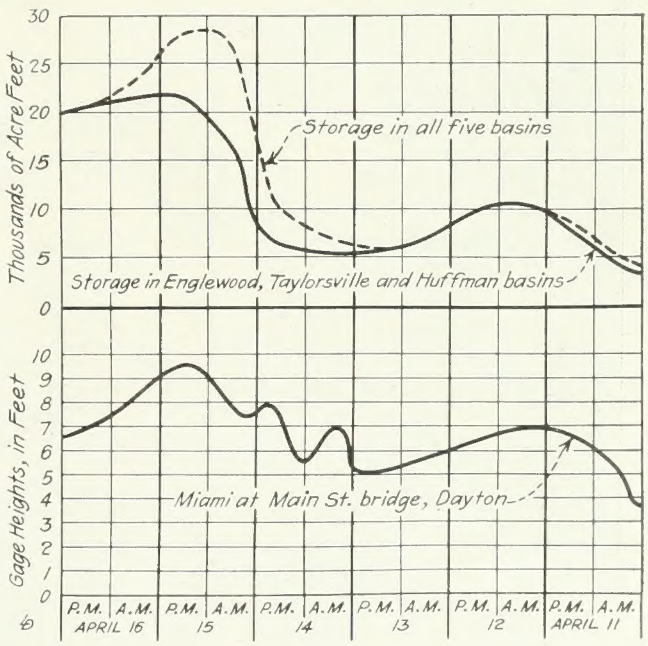

FIG. 368—DIAGRAM SHOWING BASIN STORAGE AND GAUGE HEIGHTS OF MIAMI AT DAYTON

ton, but not so heavy above the dams. The big rain of Friday started the main rise. The little hump just before midnight was caused by backwater from Wolf Creek's rampage, which was uncontrolled by retarding basins, plus the runoff from Dayton. As shown by the upper curves, the retarding basins were beginning to get to work, and consequently the curve of gauge heights in Dayton is a hump, rather than a peak. The smooth easy curve of the present day hydrograph is in marked contrast to the jagged peaks of the graphs of earlier days.

Under old conditions, a very pointed peak would have occurred Saturday morning. The old danger stage would have been reached, and perhaps passed a little. Under the conditions at this particular time, the three dams just above Dayton were the only ones that had much effect on the stage there. They were responsible for about one-half of the reduction in the stage. The other half of the reduction came from the channel improvement. The proportion of the reduction due to the dams would be greatly increased in a larger storm. The effect of the quicker "get-away" in the towns due to the improvements, and the change in the valley storage conditions, can only be determined after long observation of similar storms. As it was, a maximum discharge of 35,000 second feet occurred at 4:00 P. M. on the 15th. The maximum capacity of the improved channel at the Main Street bridge at Dayton is 110,800 second feet, with the water three feet below the top of the levees.

Another noteworthy improvement was in the smoothness with which the water flowed. In former years, even at moderate stages, the waters of the Miami were wild and turbulent, the term "angry waters" best describing the stream in flood. During the flood of April, even though the velocity has been raised by the cleaning of the river, but little disturbance was to be seen, and the river went on its way very quietly. No damage was done to the works of the District in Dayton.

Hamilton has above it a large area not controlled by retarding basins. Much of this is to the west of and very close to the city. Consequently it has two peaks to its floods, one when the water from this uncontrolled area close at hand reaches the main river, just a few hours after it has fallen, and another later when the water from the upper valley gets down. In this particular flood, the first peak occurred at 5:00 A. M. on the 15th, with a gauge height of 15 feet, at the Main High bridge, and a discharge of 54,500 second feet. The retarding basins above Dayton, together with Germantown basin on Twin Creek, so reduced the second peak that it can hardly be determined. By Saturday noon the gauge was 14.7, on Sunday it rose to 13.7 after a fall, it was 10 feet on Monday, and 10.4 on Tuesday. Just as it was at Dayton, the effect of the basins was to cut down the peak flow and to prolong a moderately high stage of the river. No damage was done to the District's work. The maximum capacity of the improved river is 210,100 second feet to the free board line. It is interesting to note that the first peak is so much in excess of the second peak. It is only for very large floods that the second will be larger than the first.

The effect of the flood upon the towns in between

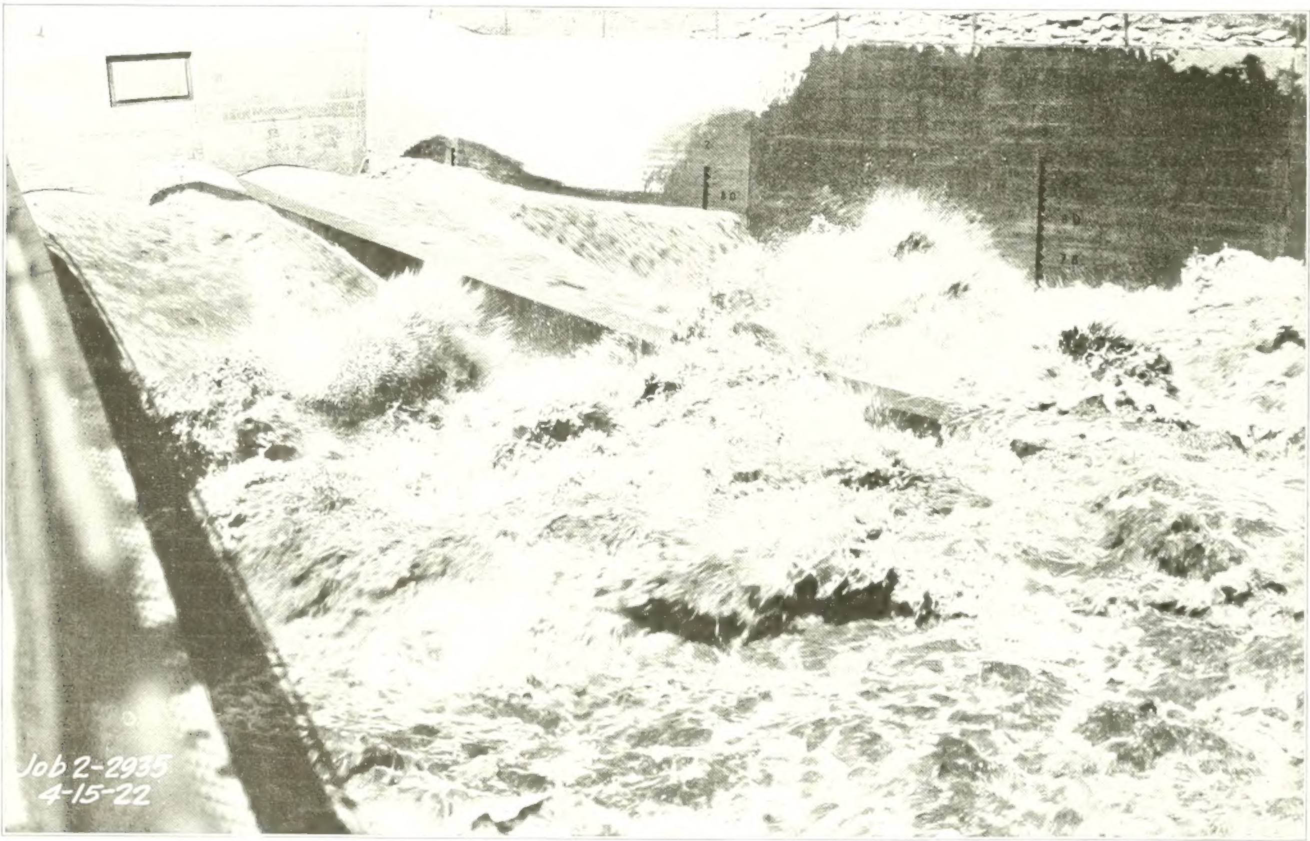

FIG. 369—THE ENGLEWOOD CONDUITS APRIL 15, 1922.
The picture gives only a meager idea of the tumult of the waters in the hydraulic jump. The wet places on the wall show how high the water leaped at times.

Dayton and Hamilton ranged between the two extremes. Troy and Piqua, affected only by Lockington basin, which does not have marked effect except during larger floods, received their benefit from the channel and levee improvement. The rain of Friday night was not so heavy above these towns as it was closer to Dayton, and on the Stillwater drainage area.

Everything went according to plan at the dams. During the rainy period preceding the 15th the water passed through them unimpeded. A small amount of storage shows on Figure 368 because the high stage caused a considerable depth of water in the conduits, and consequently some storage, but in general the inflow equalled the outflow. The rains of the 11th caused some additional storage at Englewood, but the storage dropped back on the 14th. The heavy rain of Friday evening caused a rapid increase in the storage in a relatively few hours on Saturday morning, which decreased in rapidity later in the day until the maximum was reached.

	Max. Ht. Water abv. Conduit Floor, Ft.	Max. Storage Acre Ft.	Time	Max. Cap'ty. Basins to Spillway Acre Ft.
Germantown	39.9	8,600	6 AM-15	106,000
Englewood	36.9	18,500	5 AM-16	312,000
Lockington	22.6	2,275	4 AM-15	70,000
Taylorsville	20.0	4,850	3 PM-15	186,000
Huffman	17.7	2,200	4:50 PM-15	167,000

The conduits ran full at Englewood, Germantown and Lockington. Although the elevation of the water in the basin at both Taylorsville and Huffman was higher than the top of the conduits, they were not filled, as a marked contraction occurred at the entrance. At higher heads, they too, would be filled. It will be remembered by those who have followed the Conservancy work that some of the basins hold back a greater proportion of the water flowing into them than the others, and that Englewood, and then Germantown, hold back the largest proportion. Therefore, the storage at these two places was much more impressive than at the others. Backwater in Englewood basin reached nearly to West Milton, covering a number of roads not reached before. Marked whirlpools indicated the location of tunnel inlets. At the other three dams the storage, while not so extensive as at Englewood and Germantown, made large lakes, and covered areas not hitherto flooded. The effect of the storage can be seen by reference to Figure 368. There is no peak on the curve of gauge heights for Dayton, only a rounded hill with a long slope on the downhill side. The reason why the storage curve does not fall as rapidly as the gauge height curve is that Taylorsville and Huffman with their large discharges emptied quickly and let the river stage fall. Englewood, with a small discharge and big storage retarded water for six days.

The dams behaved very well. No material physical damage was done. The slopes were cut slightly in places by the heavy rain, and some of the plantings were damaged, but the loss was trivial. Previous high waters had given opportunity to study the action of the hydraulic jump, and the studies and profiles made this time added nothing of interest to the information given on the hydraulic jump, in March 1921 Bulletin, save that this last performance confirmed the favorable results previously noted. Drift went through the conduits cleanly and with dispatch. The iron railing at the inlet end of the tunnels at Germantown was torn away by the drift and the water. This result had been anticipated, and the railing built so it would go and not damage the concrete, but the twisted pipe gave emphatic evidence of the force that hit the railing.

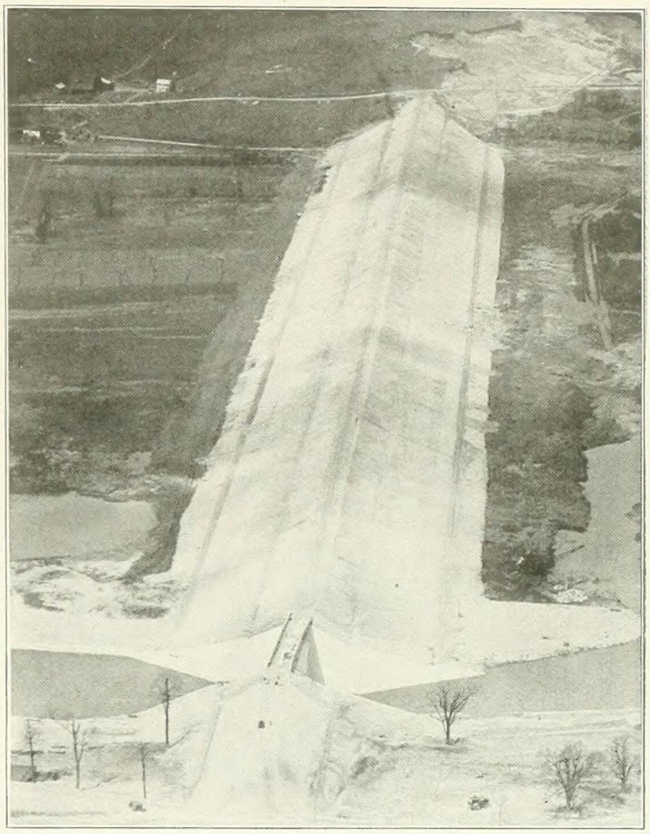

FIG. 370—HUFFMAN DAM, APRIL 12, 1922.
Photograph by Engineering Division, U. S. Army Air Service.
Very little water was being stored when this was taken.

The citizens of the Miami Valley were greatly interested in the working of the system. Germantown and Englewood were especially popular with sightseers, because of the high stage of the water in them, and because of their accessibility. Englewood, being along a paved highway, received the most attention. The crowd Saturday was very large. The sheriff took warning and on Sunday put deputies on the road to regulate traffic and keep it moving. Even with these men on duty, traffic became so dense that progress beyond a snail's pace was impossible, and the road was blocked several times.

One citizen stood a long time on the top of the Englewood Dam and looked at the lake above. Finally he said, "Well, I know that is a lake seven or eight miles long, and that it is pretty deep, and that there is lots of water in it, but it is not larger than a mud puddle compared with what the basin will hold." This fact of being big enough to handle anything that might come along, was the outstanding feature impressed upon everyone's mind by the high water of April 15th. But 32 percent of the Dayton channel capacity was used, 26 percent of Hamilton's, and only 4 percent of the basin capacity was utilized. It would take a much larger flood than that of last April to even approach the actual capacity of the system.

Black Street Bridge at Hamilton Completed

Methods That Were Somewhat Unusual Used in Constructing Important Structure.

The completion of the Black Street Bridge, on March 27, 1922, meant much to the City of Hamilton. The 1913 flood carried away the steel bridge at the foot of Old Black Street. A temporary bridge for pedestrians was erected on the piers of the old bridge, but for nine years all vehicular traffic in the north section of town had to go to the center of the town to cross the river. Besides the serious inconvenience this long detour has caused, a considerable retardation in the development of the north end of Hamilton has resulted. The construction of the new bridge has been very welcome.

The structure is a seven-span reinforced concrete arch bridge, 654 feet between abutments. Work was first started on May 22, 1920. As operations developed interested citizens noted a good many departures from the construction methods commonly in vogue in the Miami Valley, and questions have consequently been numerous. But there is nothing revolutionary about the bridge. The design is conservative and follows closely the accepted lines of present day practice. Similarly, the concrete was proportioned, mixed and handled in the most approved manner. But in the preparation of the foundations, in excavating for the footings and driving the piling, in the long cableway for handling materials, and in the form work for the arches, methods were employed that were somewhat unusual.

The most common cause of failure in concrete bridges is poor foundations. No other feature is of more importance, and no other feature is more apt to be neglected. The Miami is a treacherous and shifting stream. A footing that might do very well in some streams, would prove inadequate to meet the high water conditions of southwestern Ohio. Therefore, the concrete footings for the Black Street bridge were placed sixteen feet beneath the river bed. In turn these footings rest on twenty-foot piles driven eighteen feet further down into the gravel, and with the top two feet imbedded in the concrete. The 150 piles under each pier are sufficient to carry the bridge, even with no support from the river bed material itself. The partial failure of the second pier of the Third Street bridge in Dayton on January 20, 1921, brought bridge foundations, particularly those of the Black Street bridge, then under construction, into sudden prominence. The February, 1921, Bulletin carried detailed accounts of the Black Street bridge footings, and compared them to various existing structures in the Valley.

Nearly every contractor who has built bridges in the Miami Valley has had trouble in getting the pier footings placed. They have all used coffer-dams made of sheet piling and have almost always had trouble in working in the restricted spaces inside the coffer-dams, in keeping out the water, and in keeping men at work in the holes. At the Black Street bridge the District placed a dragline machine out in the river, dug a hole for each pier and piled up the dirt around the hole, so as to form a dike with its top above the water surface in the river. Then electrically-driven pumps were placed on the dike, and the water in the hole pumped out. Some water ran in through the gravel but the pumps were able to carry it away faster than it could run in. The longer the earth dikes stood, the less water came through their banks, as the burden of silt carried by the waters of the Miami served to stop up the voids in the gravel composing the dikes, and made them more watertight as time went on. Then the dragline with the leads and hammer of a pile driver suspended from the end of the boom, was so swung that the hammer was over the place where a pile was to be driven. The load cable of the dragline then pulled in and spotted a pile. The leads were held in position at the bottom, by pushing them into the gravel, and were held at the top by the dragline boom. The pile was driven to the required depth by the hammer, the dragline was moved around and the operations repeated. When the piling was in place, forms for the concrete footings and piers were built, and the concrete placed. After the forms were removed, the hole around the foundation was filled by pulling the material in the dike down with the dragline. All of the work was in a broad, open cut, easy to work in and where there was no doubt about what was being done. It was anticipated that rises in the river would wash out the earth dikes once in a while, and in fact it happened twice. But there was nothing to wash out except the gravel and after the water receded the breach was filled in, the water pumped out and work resumed.

The process was so simple and different that it attracted much attention. The Bulletin ran a story in the February 1921 issue describing the methods used, and the Engineering News-Record of New York also carried stories about it. A good many letters of inquiry were received. This one is typical: "I am simply writing this letter to inquire if you know why it is you can excavate for piers in the Miami River, and not use any sheeting, when

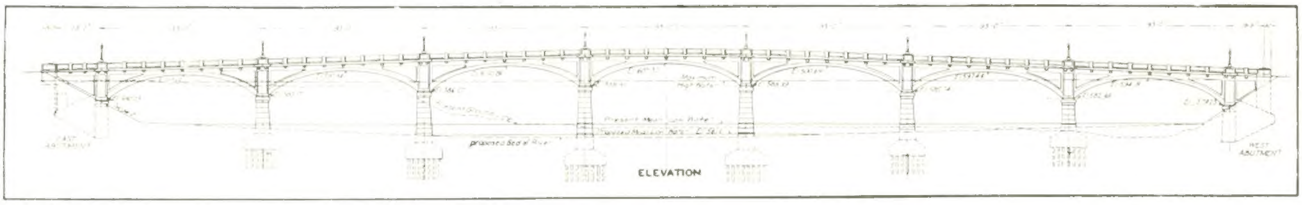

FIG. 371—ELEVATION OF BLACK STREET BRIDGE.

everyone else seems to have trouble, even after using sheeting". The answer was that "the District had not built any bridge piers in the Miami River before, and was therefore not aware that excavation could not be made without sheeting, and for that reason the District was able to get along without it." The particular questioner who was so answered did not accept the answer as a joke and thought it inadequate, but after all it really does express the meat of the matter. Such a simple and obvious thing was not done before because every one did what the person before him had done. Then too, such large equipment as the District used is not always available to contractors.

There is really nothing novel in the use of a cableway with which to handle material and forms, as similar outfits have been often used on bridge work. But in the Miami Valley most contractors have been accustomed to using concrete towers on most bridge work, or cars on trestles and the simple and efficient cable carriage was a great source of interest to the citizens of Hamilton. As the construction plant has been described in detail in the February and March 1921 issues of the Bulletin, it will not be reviewed here. The complete success of the installation in accomplishing the ends desired, should be recorded.

The fourth feature of interest is a special construction of the arch forms. In a concrete bridge the weight of the concrete and the filling over the arches and the pavement, which is the so-called dead load, is large in proportion to the live load. The dead load is also a constant thing and is definite. Therefore, the thrust on the pier from the dead load of the arch on the left is balanced by an equal thrust from the arch on the right. The pier is designed, as far as overturning goes, only to meet the stresses from the live load. In some bridges the dead load is not equal on both sides of a pier. Then the pier and footing is designed to meet the unbalanced thrust due to the dead loads, as well as that due to the live loads. But all the arches are the same length in the Black Street bridge and the dead load thrusts on the piers are all equal. While the arch is being poured, the forms under it carry the weight. The substantial character of the Black Street forms can be seen by referring to Figure 364, the footings for the post being timber piles. The arches should be supported by the forms until all are poured, and the concrete set. If the supports underneath one of the arches were removed before all the spans were completed, the thrust against the piers might push them over, as there would not be any corresponding thrust in the opposite direction to offset the thrust from the unsupported arch.

Naturally, the arch forms in such a bridge as this require a great deal of lumber. The posts and bracing have a good salvage value, but the lagging has little value save as kindling, when the bridge is finished. A substantial saving in the amount of lumber used was secured at Black Street by the use of a semi-removable falsework. First, a skeleton structure was built up on the pile foundation, as shown by the sketch in Figure 373. Five bents of 11 posts each were used under each arch.

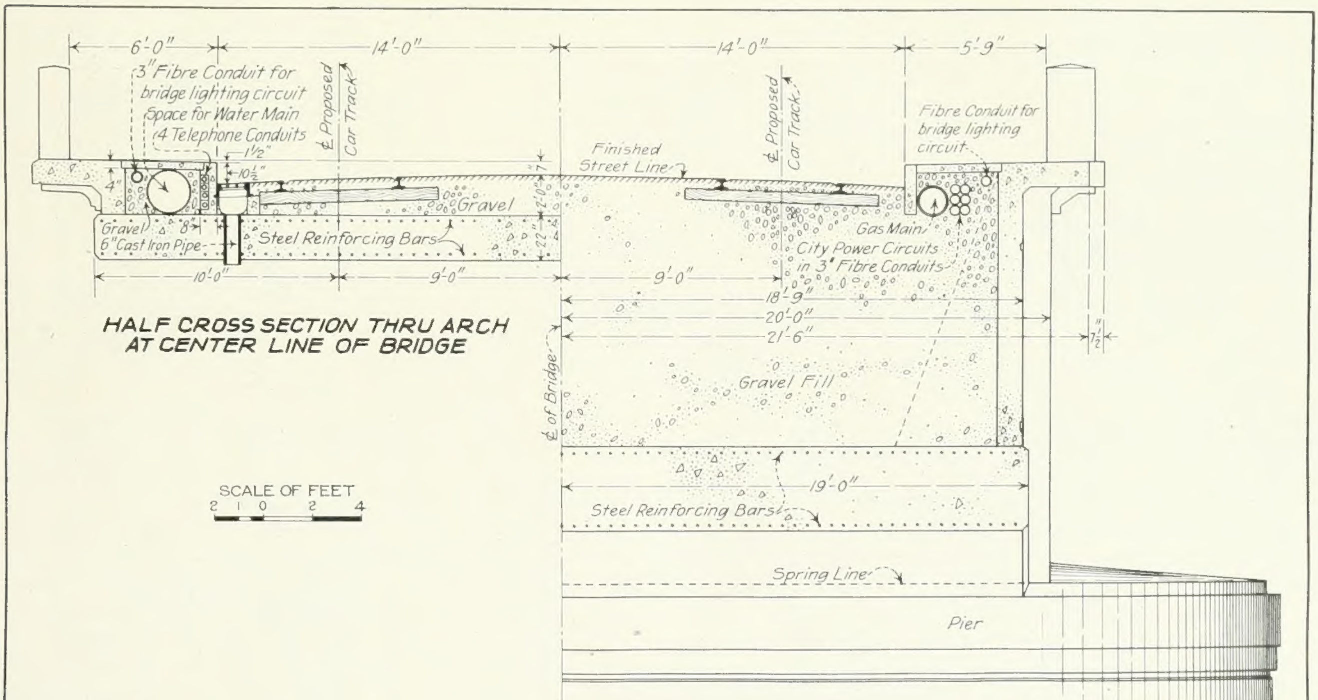

FIG. 372—DRAWING SHOWING SOME DETAILS AND DIMENSIONS OF THE BLACK STREET BRIDGE.
The tracks shown in the sketch will not be placed for the present. Extra steel in the arch is provided to carry the extra load of a street car. This can be seen in the section on the left.

These bents were placed on pile footings. At the level of the top of the piers a deck of longitudinal timbers was built, which helped brace the bents, and which also took the side thrust from the batter posts. A cap for each bent was run across the deck, both to carry the wedges for the vertical posts above, and to act as a heel for the batter posts. Then came the wedges, (to facilitate bringing the forms to the right level, and to make dismantling easy), then another cap, and then the eleven 8x8 vertical posts on each bent. This skeleton was thoroughly sway-braced. On top of the vertical posts was placed a strip of lagging, with bolts projecting upward that were gripped by the concrete after it was placed. This frame work composed the part of the falsework that remained in place throughout the work, and that carried the dead load until completion. It also afforded support for the forms for the spandrel walls and cantilever sidewalk. Full details are shown in Figure 373.

Further falsework was necessary to hold the lagging supporting the green concrete. A 2 inch by 6 inch strip of lumber was bolted to the side of each vertical post above the deck. Short caps went on top of the 2x6 strips, between the vertical posts, and these in turn carried the stringers supporting the lagging. The batter posts were independent of the vertical posts, and were supplied with wedges just beneath the cap. The stringers and lagging were cut and laid as the ordinary form work for structures of this kind.

After the arch ring had been poured, and the concrete had set, all the lagging except the strip on top of the vertical posts, the stringers, the batter posts, and the 2x6 strips, were removed, leaving the arch supported by the skeleton falsework. This was done by taking out the bolts fastening the 2x6 strips to the vertical posts, and springing them out of plumb, and by loosening the wedges at the tops of the batter posts. With the pressure off of the lagging, it was easily removed. As the posts of the falsework had been carrying all of the load, in the first place, no additional load was placed upon them when the lagging was removed, and no settlement occurred. All of the lumber which was removed was used over again. But three sets of lagging, stringers, batter posts and strips were used for the entire bridge, instead of a full set for all seven spans. The forms as built required some special mill work, but the economy in lumber was so considerable that the net saving was about $4,000. The plan was a complete success in every way.

Unusual care was taken in cutting the forms. Bolts were used as fastenings wherever possible. To insure accurate construction of the arch forms, the curves were laid out on a nearby tennis court. A framework was built of light lumber and laid down on the curves so located. Using stakes set at the centers, and proper radii, curves were marked on this framework, and the templates thus outlined were sawed out and used to mark the joists and side forms for the arches. Settlement allowances were made 0.04 feet at the center of the arch, and 0.08 feet midway between the center and the piers. The extraordinary care used in cutting out was reflected by the excellent fit secured, and the lack of alterations at the last minute.

Reference to Figure 372 will give the spacing and size of the reinforcing. The extra bars under the street car tracks should be noted. In placing the

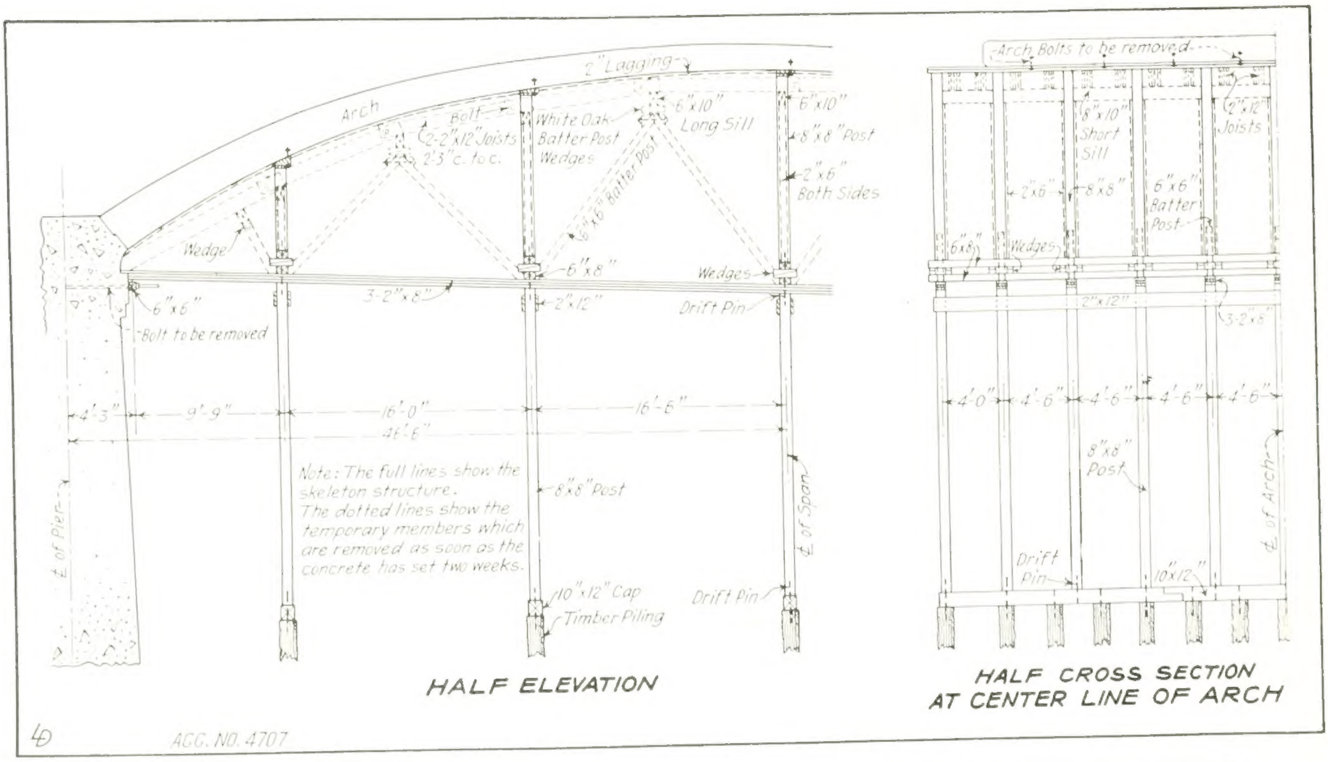

FIG. 373—SKETCH ILLUSTRATING THE ARCH FORMS ON THE BLACK STREET BRIDGE.

The sway-bracing has all been omitted on the drawing. The stringers in some cases were cut from a single piece; in others, the curved part was spiked to a straight stringer. Not all of the wedges were oak; some were good quality pine.

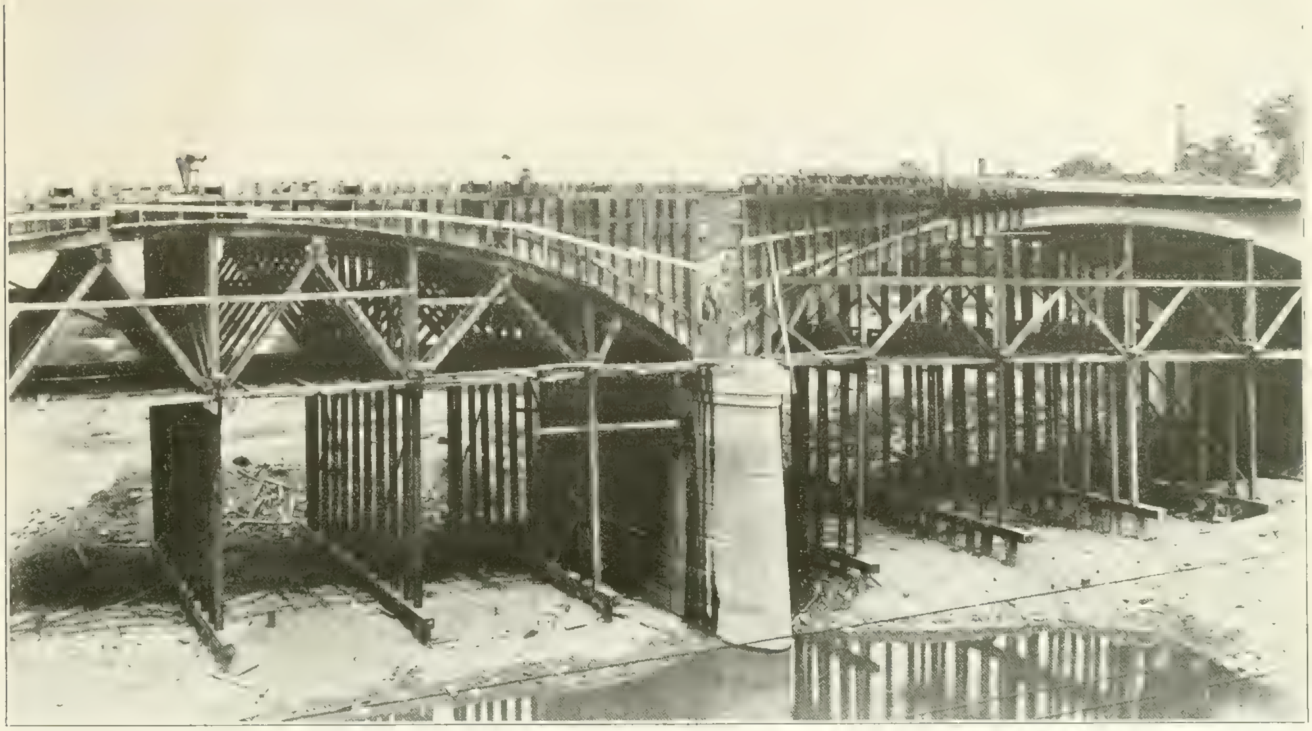

FIG. 374—BLACK STREET ARCH FORMS AS ACTUALLY BUILT, AUGUST 25, 1921.
The arch on the left has the full forms under it. The one on the right has only the skeleton forms supporting it.

steel, care was used in spacing accurately, and lacing bars of 3.8" steel pass above and below the transverse bars, forming a lattice work, and steel and concrete spacers were used to preserve the spacing.

The plant layout and the general method of handling the materials and concrete was described in the February 1921 Bulletin, in connection with the description of building the piers.

The same general methods were used throughout the construction of the bridge. Each arch was poured in three longitudinal rings of equal width, the middle one first, then the outside ones. Each ring was poured in one run. A hopper was set in the center of each arch, with a spout going in each direction down the slope of the arch. The batches were run alternately in both directions, so as to balance the loading on the forms. Back forms were used for a distance of 25 feet to 30 feet from the piers. To prevent rising of these top forms from the pressure of the semi-liquid concrete, ¾ inch rods were used to tie them down. The concrete mix in the arches was six bags of cement per cubic yard of concrete, which is nearly 1:2:4. The maximum size of the gravel used could be passed through a three-inch circular opening. Steel stubs and keys were placed in the arch concrete to connect with the reinforcement for the spandrel walls and counterforts.

The outstanding features of the spandrel walls are the use of counterforts, and the use of five expansion joints. The expansion joints split a counterfort into two parts, and extend directly through the spandrel walls, dividing each into four sections. The outside forms for the walls were built first, then the steel was placed and then the inside forms were set. The sections were poured alternately, and each section was run continuously from the arch to the top of the sidewalk. The walls were finished with one inch of mortar colored with lamp black in the proportion of 2 pounds of lamp black to a barrel of cement. Only the outside half of the sidewalk is a part of the spandrel wall. The inside half of the sidewalk will not be laid until the bridge is paved. The reason for this form of construction was to provide a place for conduits for public service lines underneath the sidewalk at the outside of the bridge. Otherwise it would have been less expensive to build the entire sidewalk as a cantilever projection. The concrete aggregates used in this part of the work were washed and screened. The coarse aggregate passed through 1½ inch circular openings, and the sand through 3/16 inch by ¾ inch slots. Slightly more than seven bags of cement per cubic yard of concrete were used, the mix being from 1:1½:3 to 1:2:4. The expansion joints were filled with ½ inch layer of asphalt and felt compound.

The pilasters over the piers were poured after the spandrel walls had been completed, and were separated from the latter by expansion joints. Fiber conduits were placed in the top of each pilaster to connect the lamp post on top of the pilaster, with the lighting circuit.

The posts for the railing were poured in place first, and after the forms had been removed the sections of rail were built between the posts. The railing is solid, in contrast to the various types of open railings in vogue in this vicinity. The scupper holes at the bottom are for the purpose of providing air circulation as a preventative of the usual dust and trash nuisance. Eight bags of cement per cubic yard of concrete were used, the mix being 1:1½:3. The tops of posts and railings were finished with a steel trowel, no mortar being used.

Steel templates were used to get a true line for the ridges on top of the railing.

Water proofing was applied to the tops of all arches, tops of piers, and to counterforts and to the backs of the spandrel walls below the top of the sidewalk. It consisted of a bituminous oil priming coat and three coats of asphalt applied in alternation with two layers of impregnated cotton fabric. The purpose of the water proofing is to prevent surface water, which finds its way down through the gravel fill, from soaking into the concrete. Weep holes are provided at the low points, the asphalt membrane carrying water to them. This work could only proceed in good weather, great care being necessary to insure a tight job. One month was required to water proof the entire bridge.

As soon as the water proofing was completed, the space over each pier and abutment was filled to a depth of 2 feet with oversize stone from the screening plant, to provide free drainage. This stone was carefully placed by hand around the drain pipes.

Then, with 4 yard dump cars running over a 36 inch gauge track, gravel and sand from the channel excavation was brought in to complete the filling. This filling is part of the dead load. As the arches and piers were designed upon the assumption that the dead load was all in place, it was necessary to distribute the fill in proportion to the finished depth over the entire bridge. To have completely filled one arch with the others empty, would have resulted in unbalanced loading. The filling was thoroughly saturated, and washed into place around posts and corners. Very little settlement is expected, but the paving will not be placed until even the minor settlement has ceased.

The tracks of the Hamilton Belt Railroad Company crossed the site of the west abutment of the new bridge. The railroad company objected to a shift in the track, so it was planned to carry the track on piling until the concreting was completed. When the time came to drive the piling, a greater penetration than 12 feet could not be secured, even with the use of iron protection shoes. A test pit dug by hand disclosed a layer of very compact gravel. It was not cemented, but was so graded that it had a small percentage of voids. The railroad company brought in a heavier hammer, and pounded the best part of a day on a high grade oak pile about 30 feet long, fitted with an iron shoe. A slow penetration was apparently secured, but on account of the slow progress the railroad company agreed to the track shifting, and the work progressed again. When the oak pile was dug out in excavating for the abutment, the slow penetration was discovered to really be a pounding up of the pile, which is shown in Figure 375. The pile had hardly made a dent in the gravel.

The hazards of bridge building are well known. It is worth noting that the Black Street bridge proved to be an exception to the rule in respect to personal injuries. But one serious accident occurred, that of a broken leg from a fall. There were not many changes in the working force. The spirit and interest shown by the men was unusual.

Save in the depth and security of the foundations, there is nothing unusual in the design of the bridge. The best present-day methods were used in the calculations. The following tabulation shows the assumptions upon which the design was based. It should be noted that the maximum stresses are only about one-fourth of those that would break the materials.

Weight of concrete, 150 pounds per cubic foot.

Weight of earth fill, 115 pounds per cubic foot.

Live load on roadway, 200 pounds per square foot, or a concentrated load of one 20-ton truck.

Live load on line of proposed street car track, one 50-ton street car.

Live load on sidewalks, 100 pounds per square foot.

Maximum stresses in arches under maximum live and dead loads and temperature changes:
- Steel 16000 pounds per square inch.
- Concrete 635 pounds per square inch.

Maximum stresses in remainder of structure.
- Steel 14000 pounds per square inch.
- Concrete 500 pounds per square inch.

Maximum load on the piles, 30 tons, assuming the gravel to carry no direct stress.

The dimensions of the bridge are shown in the various illustrations. The following is a list of the principal quantities:

Excavation	21992 cubic yards.
Backfilling	7434 cubic yards.
Waterproofing	36086 square feet.
Railing	1393 lineal feet.
Concrete in piers	6921 cubic yards.
Concrete in arches	1988 cubic yards
Concrete in spandrel walls	693 cubic yards.
Timber piles	15953 lineal feet.

FIG. 375—RESULT OF AN UNSUCCESSFUL ATTEMPT TO DRIVE AN OAK PILE THROUGH COMPACT GRAVEL AT BLACK STREET BRIDGE.

Progress on the Work From March 21, 1922 to June 26, 1922

GERMANTOWN

Completed.

ENGLEWOOD

Since the date of the last progress statement, March 20th, 1922, the work performed has consisted principally of the various minor items necessary for the completion of the finishing touches on the dam. Grading on the downstream slope is finished and the ground seeded to sweet clover. The upstream side is about 75% graded and partially planted with wild honeysuckle. The surface drainage system, comprising catch basins on top of the dam and on the berms and vitrified pipe down the slopes, is well under way. The guard rail on top of the dam is completed and is being painted. Riprap is being placed on the upstream side to elevation 825, the height to which a flood equal to that of 1898 would come. The stone for this is quarried at Ludlow Falls by forces of the District and transported to the dam by District trains. The Model "36" Marion dragline is moving along the toes of the dam, grading the top soil storage piles and smoothing up the scars incidental to construction operations.

The relocation of the Dayton Covington & Piqua traction at the spillway bridge, is completed, traffic being turned over the new line on June 23d. Filling the narrow gap between the spillway bridge and the Covington Pike, where the traction formerly ran, has been started, and will be completed in a few days.

The cut-off road between Roads 4 and 5, has been completed, guard rail erected and the road opened for traffic.

Under the contract with Connell & Rohrer for the removal of the Prairie Ford Bridge the structure has been dismantled, removed to the new location, and is being cleaned, painted and re-erected.

H. S. R. McCurdy, Division Engineer.

June 26, 1922.

LOCKINGTON

Completed.

TAYLORSVILLE

The principal items of work finished since the last report of March 20th are the guard rails on the main dam and on Road 12 leading from the east end of the dam to the National Road, the catch basins on the top and berms of the dam, the seeding and dressing of the slopes, and the removal of the old club house which stood partly in the toe of the dam and the filling of the cellar of this house.

The caretaker's house has been finished and about a mile of fence has been built around some pasture land for him. Fifty-three of the camp buildings and a number of garages have been sold and the most of these have been removed from the premises.

In a day or so all tools and equipment not needed by the caretaker will be turned in to the Salvage Department.

Taylorsville Dam is finished.

O. N. Floyd, Division Engineer.

June 26, 1922.

HUFFMAN

At the time of the report in the April Bulletin, the major items of work had been finished. Since then the placing of a blanket in the old river channel above the dam has been completed. The necessary protection to the banks of the channel, has been made by riprapping the slopes with rock.

All the locomotives, cars and other hauling equipment have been shipped away from the job, and all construction tracks taken up except a short section connecting the storage yards below the south end of the dam with the Erie Railroad. After the two draglines had finished their work they were tracked across the river and up around the south end of the dam through a small gap that had been left in the dam where it ties into the Springfield Pike. This gap has since been filled.

Guard rails have been built along both sides of the top of the dam from the Valley Pike at the north end to the bridge over the spillway. Ditches have been made along the sides of the highway on top of the dam to carry the surface drainage to the rock gutters down the slopes. After the completion of the short section of guard rail between the spillway bridge and the Springfield Pike at the south end, and a little work on the road surface, this highway will be opened to the public.

Concrete paving has been placed on the slope of the bank above the concrete wall on the north side of the hydraulic jump pool below the conduits. Various other sections of rock paving and riprap around the outlet works have all been completed.

Work has been started on clearing the river banks below the dam. All trees and underbrush that have a tendency to collect drift or retard the flow of the water are being cut out. This clearing work will be to a point about one-half mile below the dam.

With a few exceptions, all the buildings in camp have been sold and are being removed by the purchasers.

C. C. Chambers, Division Engineer.

June 26, 1922.

DAYTON

The principal work remaining to be done is the completion of channel excavation and levee building along the left bank of the Miami River. Early in July all of the levee upstream from Stewart Street will have been finished and the three big draglines, two Bucyrus, Class "175," and one Lidgerwood, Class "K," will be working on the section between Stewart Street and the plant of the Dayton Power and Light Company.

Price Brothers Company has nearly completed the required revetment work.

An agreement has been entered into with Frank Hill Smith, Inc., for the construction of miscellaneous concrete structure remaining to be built. This work includes sewers, crest walls, coping for the large river walls, steps on the levee slopes, etc. The work is now under way.

Leslie Wiley, working under contract agreement, is cleaning up material which could not be reached by the big draglines under and around the bridges.

Surfacing and seeding of levee slopes on the south bank of Mad River and on the west bank of the Miami River between Third Street and Dayton View Bridges has been done by John E. Freudenberger, under contract.

On the north bank of Mad River, west of Webster Street, a privately owned gravel plant is operating under supervision of the District. This is a "pit run" plant, no screening or washing apparatus having been installed. Another plant for screening and washing the product will soon be installed on the south bank of Mad River, just west of Findlay Street. These plants, as well as the plant already in operation on Wolf Creek, above Summit Street, excavate from the stream beds material which would otherwise drift into the improved channels farther downstream.

Total channel excavation, item 9, up to June 1st, amounted to 1,605,000 cubic yards. Levee embankment amounted to 623,900 cubic yards. To accomplish this work, the total yardage handled amounted to 3,913,000 cubic yards.

C. A. Bock, Division Engineer.

June 26, 1922.

HAMILTON

The electric dragline, D-16-18 has completed a cut from the Main Street bridge to the Black Street bridge along the east bank of the river. It has started south again and is removing the remaining excavation in the middle of the river.

The class 14, Bucyrus caterpillar dragline has finished the levee north of Two Mile Creek and the west channel bank from Two Mile Creek to Black Street. It is now finishing the bottom south of Black Street along the Champion Coated Paper Company's wall.

The class 14, Bucyrus dragline on rollers has completed the Four Mile Creek cut-off channel and is now excavating and driving piling for the east abutment of the dam which is to be built north of Old River and Two Mile Creek. This will be a concrete dam with a spillway section 800 ft. long, and will raise the low water level about 5 feet. Concreting has been started on the west abutment of the dam. The excavating for this abutment was made by the Class 14 caterpillar after completing the Two Mile Creek levee.

The Model 21, Marion dragline has prepared the east bank between High Street and Vine Street for the slope revetment and is now building the levee along the north side of the spoil bank east of the Ford plant.

The concrete walls along Monument Avenue and Front Street have been completed. The wall south of Two Mile Creek is about 75% complete.

Price Brothers are making good progress on the revetment on the east bank north of High Street.

The total amount of channel excavation, item 9, to June 1, was 1,661,000 cubic yards.

C. H. Eiffert, Division Engineer.

June 26, 1922.

PIQUA

The dragline is now filling the gap in the levee between the Decker Packing Company's plant and Station 60. This work was delayed because of high water early in the spring, and because the material used in the fill is hard to secure and handle. The Shawnee levee is being built by teams. Additional equipment is to be placed in this section of the work.

The levee west of the Miami River is nearly completed and a steam shovel and cars will soon be at work on the Water Street levee.

The raising of the Rossville bridge has been completed. Some work remains to be done at the approaches.

Albert Schroeder, Assistant Engineer.

June 26, 1922.

UPPER RIVER WORK

Troy—The dragline D-16-21, after undergoing repairs, started work again in the middle of May, and is busy cleaning out the channel in the vicinity and under the Adams Street Bridge. Under each arch the channel is being excavated below grade to a depth of from 2½ to 4 feet. This excavation will receive the material in the old arches when they are torn down. The dragline work will be completed about August.

The work of strengthening the piers of the Adams Street bridge has been completed by Price Brothers, and the work of reconstructing the bridge, which is being done by the forces of the District, is making very good progress. All of the piers, except the tops of A, B and C have been poured; both abutments and the three north arches are complete. The forms for the spandrel walls and sidewalks for the three north arches are well under way, and the falsework completed for arches 1, 2, 3 and 4. Except for Arch No. 2 the arch steel has all been placed.

Price Brothers have been driving piling along the right bank of the river for revetment, which is to be placed as soon as the men and equipment are released from the bridge work at Piqua.

The Coleman wall, and some cleaning up work at and near the Market Street Bridge, has been completed.

Tippecanoe City—Since the report in the April Bulletin, I. C. Mercer and Sons have completed the Fourth Street sewer as far as South Street. So far, 1240 feet of 66-inch, 1210 feet of 51-inch, and 650 feet of 42-inch concrete sewer has been laid. There still remains 1000 feet of 36-inch sewer and about 80 feet of tile at the upper end to be placed. August 1st should see the end of this section of the work.

The Bull Run Ditch being built under contract by Wm. Oberer is near completion. The only work remaining to be done is the finishing of the slopes, and the Ritter Street culvert. The same contractor has also placed the earth fill for the raising of Main Street between First Street and the Miami and Erie Canal, and hauled about 1000 cubic yards of material into the main levee to make the connection with the Main Street wall.

The District forces removed and cleaned 44000 bricks from Main Street, and have completed the street work where North Second Street crosses the levee. Walls in connection with the raising of Main Street have been completed and work is now under way on the wall south of Main Street.

J. Connelly's team outfit started work completing the levee from Station 41 to the power house, on June 12th. This is the section the dragline had to leave because of sliding banks.

A. F. Griffin, Assistant Engineer.

June 26, 1922.

LOWER RIVER WORK

West Carrollton—Completed.

Miamisburg—Since the report dated March 20 Price Brothers have completed the flood gate structure in the Miami and Erie canal near the north corporation line. The five flood gate jobs in Miamisburg are now complete. Total concrete in these jobs is 1000 cubic yards.

On the sixth of May Price Brothers started driving steel sheet piling for the revetment which will be placed along the east bank of the river from a point just above the end of Lock Street downstream 900 feet. The depth of the river in this location made it necessary to drive sheet piling from 8 feet to 15 feet in length. This work was completed June 6. In constructing a two-to-one slope from the water surface upon which to place the revetment it was necessary to move about 1500 yards of material. Price Brothers did this with their small dragline. The grading is done and concreting will soon be started.

Franklin—No further work has been done since the report in the April Bulletin.

Middletown—Price Brothers started the flood gate job in the Miami and Erie canal on Tytus Avenue, April 1st, and completed this work the last of May. There are 213 cubic yards of concrete in this structure which carries four 4 x 5 gates.

Timber clearing along the overflow areas of the river channel in Middletown has been completed, and the clearing above the Poastown Road bridge is nearly finished.

F. G. Blackwell, Assistant Engineer.

June 26, 1922.

RAILROAD RELOCATION

Big Four and Erie—Completed.

Baltimore and Ohio—Completed.

Ohio Electric—Completed.

RIVER AND WEATHER CONDITIONS

The total rainfall at Dayton for the period since the report in the April Bulletin was 11.87 inches. Of this amount 5.38 inches was precipitated in April and 4.16 inches in May. The April rainfall was 2.48 inches more than normal for this month. On April 13-14 a heavy storm occurred and 3.11 inches of rain fell in Dayton in the 24 hour period. This storm was general over the Miami Valley and caused a considerable rise in the streams and impounded water in all of the District basins. Details of this storm and its results are related elsewhere in this issue. On June 8, a very heavy local storm caused a rainfall of 2.50 inches in one and three-quarters hours at the Lockington Dam. There were 10 clear days and 11 on which more than 0.01 inch of rain fell, while May had 12 clear days and 17 on which rain fell. However, the total rainfall in May was only 0.28 inch more than normal for this month.

Temperatures during the period were moderate and not far from normal. The lowest temperature was recorded on March 23 and was 32 degrees while the highest temperature during the period was 92 degrees, which was reached on June 16. The mean temperature for March was 44 degrees; for April was 54 degrees; and for May was 66 degrees.

Wind velocities were not unusual, the maximum (for five minutes) being 52 miles per hour on April 11.

C. S. Bennett, Field Engineer.

June 26, 1922.

Meeting of the American Society of Civil Engineers a Success

With flood prevention as the topic for discussion, the American Society of Civil Engineers held its spring meeting in Dayton, on April 5th, 6th and 7th. With the nearly completed flood prevention works before them, a number of distinguished engineers discussed the Miami Valley's solution of the flood problem, and presented papers on similar problems that exist elsewhere. Inspection trips to two dams and over a portion of the river improvements were made. The Engineering Division of the Air Service at McCook Field, the National Cash Register Company, and the American Rolling Mills at Middletown, entertained the society. These were all the inspection trips that could be included in the two days allotted, and the greater part of the District's work, and other industries that were anxious to entertain the visitors, could not be seen.

The Engineering News-Record in commenting editorially upon the meeting, said, "In the record of gratifying success made by the American Society

of Civil Engineers in its Dayton meeting there lies far more than an isolated fact in the society's career. The meeting marks an epoch in the life of this great professional body. Long tied up in rather rigid and routinized practices, the society broke away from these and for the first time held a regular meeting away from headquarters. It took the meeting to the members out in the field. The response was a surprisingly large attendance and an intense interest . . . . . . During the current season the last work will be done on the Miami Conservancy District construction. The Dayton meeting was a fitting and quietly impressive valedictory, as was remarked by the most energetic and resourceful promoter of the project. So quickly has the work run along during the four-year construction period that it has attracted far less notice than it deserves. As a detail, it progressed to completion without incident or accident. One of its greatest distinctions, however, is that virtually every element of the work embodies new methods, research discovery, or development of better practice, to a degree that makes this one enterprise a splendid model. As it has been a great school for the chosen group of engineers who were engaged in it, so it will long be a school for all concerned with hydraulic engineering in any phase, and flood-protection in particular."

The meeting was preceded by a meeting of the Board of Direction of the Society, on the 3rd and 4th. The Board was entertained at dinner on Monday night by the Dayton section of the Society, and on Tuesday night by the Dayton Engineers Club. On Wednesday noon, the Dayton Chamber of Commerce held a luncheon in honor of the visiting engineers, at which John R. Freeman, President of the American Society of Civil Engineers, and J. G. Sullivan, President, Engineering Institute of Canada, were speakers.

On Wednesday, the 5th, the technical meeting started with the registration of the 350 visiting engineers. Sessions were held morning, afternoon and evening. Led by President Freeman, the subjects of the papers and discussions ranged from flood-stricken China, to the lowlands of the Mississippi, and to sand and tidal waves. Cloud bursts on small areas were discussed by a number of speakers. During the evening session Mr. A. E. Morgan, former Chief Engineer, and Mr. Chas. H. Paul, present Chief Engineer, told of the work of The Miami Conservancy District.

Thursday and Friday were given over to inspection trips. In arranging these, the endeavor was to show to the visitors features that were of interest to engineers, and would exhibit characteristic products of the Miami Valley. Flood protection, cash registers, airplanes, and Armco iron were the products selected as exhibits. The Engineering Division of the Air Service opened McCook Field to the visitors, took them over the wonderful plant, staged exhibition flights by many types of planes, put on an aerial circus in front of the Engineers Club during the noon hour on Wednesday, and another while the engineers were at the Englewood Dam. The National Cash Register Company entertained the visitors to dinner at their plant, took them over the great factory, gave their shop lecture, and took them to the roof of the office building for a birdseye view of the lower end of the Miami River improvement. The American Rolling Mills took the party to Middletown on a special train, served luncheon, and took them through their East Mill, where Armco iron is made, and furnished a special train to return.

Two typical dams, Englewood and Huffman, and the Dayton River improvements were shown. The two dams were virtually completed, but at Dayton an opportunity was given to see some of the work under way. As Colonel Deeds said at the banquet at the Miami Hotel, the visit of such a distinguished group of men was the best ending to the work that could be made.

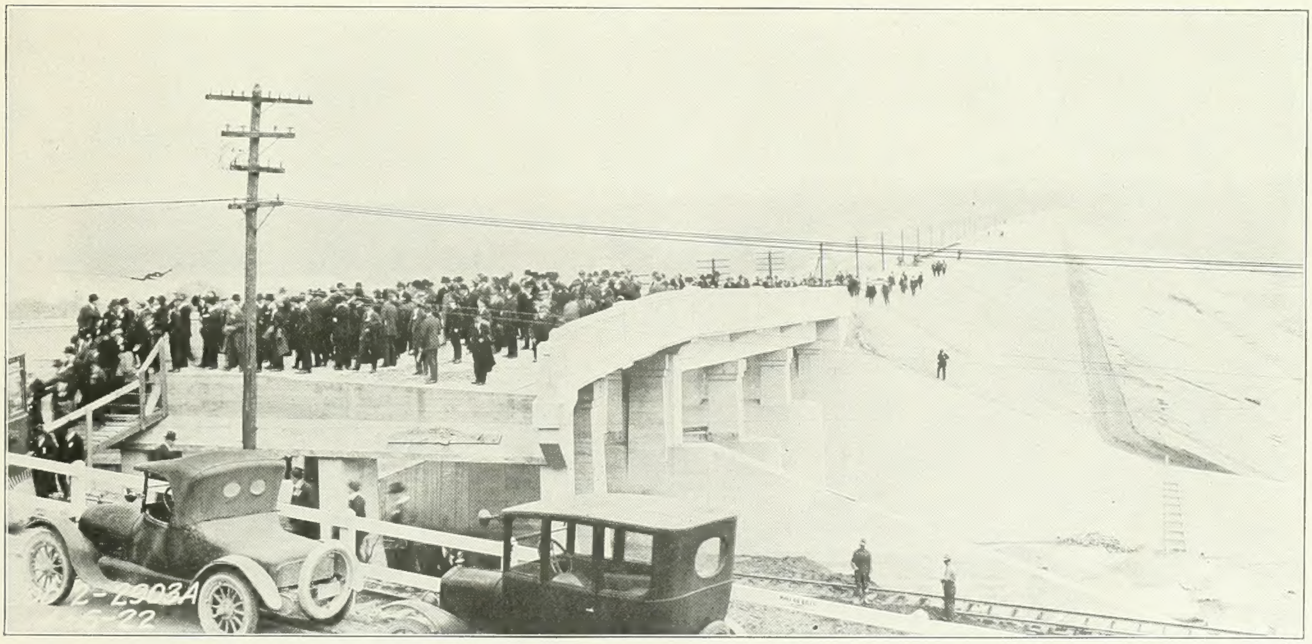

FIG. 376—MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS AT ENGLEWOOD DAM, APRIL 6, 1922.

FIG. 377—PANORAMIC VIEW OF HUFFMAN BASIN ON APRIL 15, 1922.

The water in the basin was nearly 18 feet deep over the floor of the conduit tunnels. This was the first considerable storage that had occurred in this basin. The water was backed up over the lower end of the old Springfield Pike for the first time. The new location of the Springfield Pike can be seen just below the edge of the railroad cut. It crosses the cut on the arch bridge seen at the extreme right of the picture. The railroad tracks in the right foreground are those of the Erie and Big Four. The Ohio Electric tracks are between the cut and the Springfield Pike.

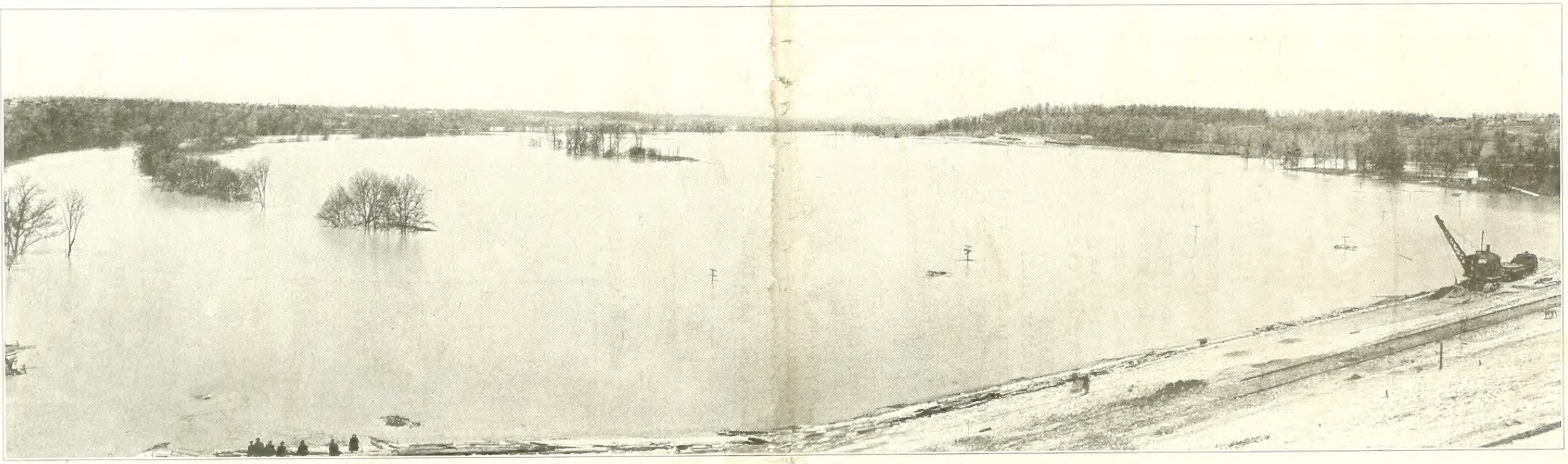

FIG. 378—VIEW LOOKING UPSTREAM FROM THE SIDE OF THE ENGLEWOOD DAM. APRIL 15, 1922

This shows conditions similar to those shown in the cover picture. The water is about 36 feet deep over the floor of the conduits. Nearly a foot more of storage was secured before the crest was reached. The whirlpool in the lower left hand corner marks the entrance to the conduits.